AD-A187 646 STUDIES OF FLUORINE COMBUSTION(U) EMORY UNIV ATLANTA GA 1/1
M KAUFMAN 03 SEP 87 AFOSR-TR-87-1923 AFOSR-86-0220

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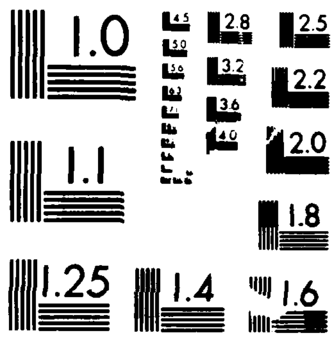

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19. ABSTRACT (Continue on reverse if necessary and identify by block number)

This program has funded the purchase of a Coherent Inc. CW ring dye laser with intracavity doubling capability exacted by an 18 watt Ar ion laser. This laser system will be employed as a sensitive and specific probe for intermediates in the combustion of various fuels in F_2. Because of their extreme exothermicity, many such reactions have considerable potential for propulsion applications.

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The following items of equipment have been purchased and installed in our laboratory:

		Cost[a]
1.	Optical Table, Newport Corp. model RS-410-8	$ 5,150.
2.	Support System, Newport Corp. model NN4-22	860.
	Items 3-7 from Coherent Inc.	
3.	I-100-19 Innova Argon Ion Laser	47,500.
4.	CR-699-21 Ring Dye Laser	48,000.
5.	7500-05 Frequency Doubler	12,000.
6.	304 Modulation System	1,590.
7.	Doubling Optics (extra ranges)	3,320.
8.	Microvac Vacuum Pump, Stokes model 21GV4D	4,800.[b]
9.	laser dye assortment, Exciton Co.	686.[b]
10.	fluorine regulator and purge, Matheson Corp.	815.[b]
11.	pump connectors, Alcatel	32.
12.	miscellaneous fittings, Georgia V&F	115.
13.	windows, Harshaw	85.
	Total	124,953.

Notes

a) quoted prices; actual costs may differ slightly due to shipping costs, see accounting report

b) items 8,9 and 10 discussed in letter of 7/21/87 to program manager

In addition, we will receive as donations from Coherent Inc. a $LiIO_3$ doubling crystal with optics (model 7501-01, price $5000) and a rotation assembly for this crystal (model 7502/3, price $1000).

Technical

The purchased state-of-the-art laser system provides a minimum of 10 mW of cw laser power over the wave length range of 267-1000 nm. Linewidths of 1 MHz can be achieved with this system. Because of the late delivery of the laser system, no results can yet be reported with this equipment.

Our experiments will proceed in the following order:
1) A gas-phase cell for laser-induced fluorescence (LIF) measurements has been constructed and will be used to record the LIF spectrum of I_2. The high density of sharp lines in this spectrum will be ideal for accurate wave length calibration of the laser throughout its spectrum.

2) The first combustion intermediate that we will study will be the CH radical. The A state of this radical can be accessed with coumarin dye. In order to familarize ourself with the LIF spectrum of this radical, it will first be generated in a low-pressure flow system. The radical will be produced from $CHBr_3$, either by reaction with hydrogen atoms or by electric discharge or photochemical decomposition.

3) The LIF spectrum of CH will then be used to monitor this radical in low-pressure F_2-CH_4 premixed flames. One objective of these studies will be to attempt to correlate the concentration of ground state CH radicals with emission from excited states of CH in this flame. One mechanism proposed for CH emission in oxygen-free combustion involves transfer of H+F recombination energy to CH, and this mechanism would predict such a correlation.

4) Laser scattering will also be employed to monitor the onset of soot formation in F_2-CH_4 and F_2-C_2H_2 flames. One model of soot formation in combustion involves nucleation on small chemically formed ions.[1] We have found that in F_2-hydrocarbon combustion, chemiions can be completely eliminated by removing oxygen impurity.[2] Comparison of the

onset of soot formation in flames burning in purified and oxygen-containing fluorine thus provides a simple method of testing for the importance of the proposed model.

5) Under a range of operating parameters F_2-CH_4 flames burn with oscillations or pulses, rather than as steady flames.[3] The chemical mechanism responsible for these phenomena are presently unclear, since unlike oxygen-supported combustion, opportunities for alternative pathways of reaction are much more restricted with univalent fluorine than with divalent oxygen. By probing the time course of the concentration of intermediates, such as CH, in oscillating and pulsed F_2-supported combustion, we will attempt to derive and test models for these phenomena.

Emory University has provided us with a $10,000 account for use in connection with our project. In addition, Emory is granting the principal investigator a one-semester leave from teaching in order to facilitate the development of our laser methods for studying fluorine-based combustion. In preparation for our experimental program, the principal investigator attended the Gordon Research Conference on Physics and Chemistry of Laser Diagnostics of Combustion, at Plymouth, New Hampshire, during July 13-17.

References

1) H. F. Calcotte, "Mechanisms of Soot Nucleation in Flames -- A Critical Review", Comb. Flame, 42, 215 (1981)
2) D. Jones and M. Kaufman, "Combustion of Hydrocarbons in Purified Fluorine", Comb. Flame, 67, 217 (1987)
3) M. Kaufman, annual report AFOSR Grant 84-0196, Aug. 31, 1985

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